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Cover

Tenth Anniversary Commemorative Logo—A drawing by Paul Calle, made in July 1969, shows an Apollo 11 astronaut as he suits up for the fantastic journey to the Moon.

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Letter from Washington

Dear Colleagues:

It is fitting that, ten years after the first men landed on the Moon, we salute that hard-won achievement as a symbol of all than can be done when public will, human intelligence, and technical resources are marshalled toward a clear objective. Perhaps the greatest lesson—and the hardest to learn— is that Apollo marks a beginning, not a high point, in mankind's continuing search for knowledge and response to challenge. The Apollo legacy is one of scientific and engineering excellence, and a decade from now we should be as proud in looking back on our work of today as we are today in looking back on the accomplishments of lunar exploration.

With the advent of Shuttle operations, we will have cracked the shell of gravity and atmosphere—the terrestrial egg, so to speak—and begun seriously to tap the potential of space for the benefit of Earth.

How fortunate we are to be living in these times, to be able to witness and even to participate in events of such unprecedented significance. Yet for us at NASA that good fortune carries with it a sobering responsibility. Apollo showed us—with high drama, great pride and a salting of unavoidable wonder—what we *can* do, as a nation and as a civilization. The challenge which confronts us now, a decade down the time-stream from Tranquility Base, is what we *should* do. What balance do we strike between science, exploration, and services; between immediate, near-term and future goals? The challenge we now face is to decide wisely and well how best to utilize the new and expanding capabilities so gloriously pioneered by Apollo for the maximum good of our nation, our civilization and the generations of humanity to come.

Sincerely,

Robert A. Frosch

New Weather Satellite

A new environmental monitoring satellite soon will join its twin in space, completing an information-gathering system considered vital to national weather forecasting.

NASA will launch the NOAA-A spacecraft (NOAA–6 once operational) into near-polar orbit for the National Oceanic and Atmospheric Administration (NOAA) from the Western Test Range near Lompoc, Calif. The Goddard Space Flight Center has management responsibility through checkout of the spacecraft in orbit at 833 kilometers.

Data from the satellite primarily will be used by NOAA's National Meteorological Center in Suitland, Md., to improve numerical weather forecasts, the basis for most National Weather Service (NWS) predictions.

An identical satellite, Tiros-N, launched by NASA last October, has been providing highly accurate meteorological information on a worldwide basis. Its orbital characteristics are such, however, that a second satellite is required to permit continous coverage of the world's weather for the National Meteorological Center's analysis and forecast cycles. The newly launched spacecraft fills in data-void areas, especially over the oceans. Because it crosses the equator six hours after Tiros-N, NOAA-A will, in effect, double the amount of data made available to the center.

Computer-prepared forecasts from the center, based on millions of pieces of information, are distributed twice daily to NWS offices across the country. These are fundamental to most local and regional weather forecasts. Additionally, the center prepares the longer-range forecasts for marine, agricultural, and aviation interests.

Feeding the giant NOAA numerical forecast computers is NOAA-A's primary task, but data and space pictures collected by it and by Tiros-N also are of value to oceanographers, hydrologists and other scientists. Experience with Tiros-N to date substantiates pre-launch expectations that the improved and expanded environmental information gathered by the spacecraft would mean more exact determination of sea surface temperatures, and more precise data on snow cover, snowmelt, and rainfall. That kind of information is important to fishing and marine shipping interests, as well as to water resource managers and to those concerned with flood forecasting.

Tiros-N also has provided highly accurate information on high energy solar radiation levels above the

atmosphere of concern to space missions, high altitude commercial aircraft flights, long-range communications and electrical power distribution networks.

Direct broadcast of pictures from both NOAA-A and Tiros-N will provide a look at local weather from space for receiving stations in more than 120 countries around the world.

These stations will receive two visible images daily and four infrared images as the satellites pass within range of their antennae.

During the remainder of this year, the twin spacecraft will be key elements in the Global Weather Experiment, the largest international scientific experiment ever held. Scientists from the more than 140 nations participating are seeking to gauge the practical limits of weather forecasting, and to design a world weather observation system to achieve them.

Tiros-N and NOAA-A, each viewing every part of the globe twice in a 24-hour period, are especially important in providing information from remote locations where more traditional weather-gathering methods are impracticable.

NOAA plans to keep two spacecraft of the Tiros-N series in orbit at all times through 1985. According to projections, inasmuch as their life expectancy is two years, a total of eight such satellites will be required.

Instruments on board Tiros-N and NOAA-A take measurements of temperature and humidity in the Earth's atmosphere, surface temperatures, surface and cloud cover, water-ice-moisture boundaries, and proton and electron flux near the earth. They are capable of receiving, processing, and re-transmitting data from free-floating balloons, buoys and remote automatic stations distributed around the globe, and aslo can track moving stations such as ships.

The last three spacecraft of the series will carry search and rescue instruments as proof-of-concept for a system that could aid in locating lost aircraft and ships. The satellites are built by RCA Astro Electronics, Princeton, N.J., at a cost of about $15 million each.

The stratospheric sounding unit on board, for measuring temperature and humidity in the atmosphere, comes from Great Britain; the data collection and platform location system known as ARGOS is provided by France. Remaining sensors were developed in the United States.

The launch vehicle for NOAA–A is a standard reconditioned Atlas E/F, with the second stage a part of the spacecraft. The Atlas is made by General Dynamics, San Diego, Calif., and the apogee kick motor assembly is manufactured by Thiokol Corporation, Ogden, Utah.

Six Landsat ground stations now are in operation outside the U.S.: Prince Albert, Saskatchewan and Shoe Cove in Newfoundland, Canada; Chiaba, Brazil; Fucino, Italy; Kiruna, Sweden; Tokyo, Japan. A seventh station near Tehran, Iran, which began receiving data last fall, interrupted its operations in January. Three other foreign stations are under construction in Argentina, Australia and India, and a number of others are in the planning stages.

U.S. ground stations for Landsat are located at Fairbanks, Alaska; Goldstone, Calif.; and at the Goddard Space Flight Center.

Landsat data in use by scientists and local officials in the U.S. and by more than 100 foreign countries bear on a wide variety of applications ranging from crop inventories to flood assessment and mineral exploration. Thailand, an early participant in the Landsat program, has continued to make successful use of Landsat data for such projects as monitoring its rice crops and mapping forest cover.

NASA Launches British Satellite

NASA launched a United Kingdom satellite, called UK–6, aboard a Scout launch vehicle from the Wallops Flight Center on June 2, 1979. UK–6 became Ariel 6 when it reached orbit. The satellite will conduct scientific studies in the field of high-energy astrophysics.

Because it was the 100th Scout launch, a larger than usual crowd was present at the launch site. One observer, a newcomer to NASA, contributed the following account after viewing his first launch.

From the mile-away viewing station, it looked like a straw whimsically rising from bubbling orange soda. Relatively silent at ignition, the trim, 23-meter ivory launch vehicle paused momentarily as the gantry pulled away, grumbled as it slowly pierced the light grey sky at 7:26 p.m. (EDT), posed glamorously for photographers for several lengthy seconds, and then vanished into the cloud cover, leaving only snakes of white smoke.

About 11 minutes after liftoff, the spacecraft was injected into an easterly, 625-kilometer circular orbit at an inclination of 55 degrees. The satellite separated from the spent fourth stage 16 minutes after liftoff.

Low-hanging clouds slightly delayed the scheduled

liftoff, but the launch—praised as near-perfect by tracking specialists at Wallops—was made well inside its two-hour window.

The flight was filled with ceremonial highlights. It was not only the centennial mission for Scout, but also the last in the UK series of satellites and the last planned satellite launch from Wallops.

The four-stage, solid propellant vehicle, produced for NASA by the Vought Corp. of Dallas, has performed a wide variety of space missions—orbital, probe and re-entry—since its first launch July 1, 1960. Its launch assignments have included 78 payloads for NASA and other U.S. agencies and 21 for European nations, including Great Britain, Italy, France, Germany, and The Netherlands. The first U.S. solid-propellant vehicle ever to place a payload into orbit, Scout has established an operational success rate of almost 100 percent and it holds the record for consecutive successes among NASA launch vehicles—37 in a row between 1967 and 1975.

The smallest of NASA's launch systems, Scout was conceived and is managed by NASA's Langley Research Center in 1958 to provide the United States with a relatively low-cost reliable launch vehicle for a variety of space missions.

In its 19-year career, the 21,000-kilogram Scout has more than tripled its payload capability with little increase in dimensions of the vehicle, which today can place nearly 180-kg in a nominal 480-kilometer orbit.

The UK-6 mission, Scout's sixth for the United Kingdom, is expected to provide scientists with new astrophysical knowledge involving sources of energy that are stored throughout the universe, including quasars, radio galaxies, supernovae, pulsars, neutron stars and black holes.

Designed to operate for two years, the UK-6 satellite mission is purely a scientific one, said project scientist Dr. J. L. Culhane of University College (London) at a news conference that preceded the launch. There are "no obvious practical applications" for the planned experiments, he added.

The entire project cost, about $20 million, including data research and analysis, is paid for by the United Kingdom's Science Research Council.

Tracking, data acquisition and command transmission for the UK-6 mission is to be controlled from one station, NASA's Winkfield station in England, by the United Kingdom Operations Control Center at the Appleton Laboratory, Slough, England. Changes in operating modes of experiments and satellite pointing direction will be done by commands transmitted to the satellite by data links from the UKOCC to the Winkfield station.

UK–6 will carry three primary science instruments: a cosmic ray detector for Bristol University, and two X-ray astronomy experiments—one for Leicester University and the other for Birmingham University and the University College of London's Mullard Space Science Laboratory.

Two experiments for the Royal Aircraft Establishment, Farnborough, England, are also on board. They are designed to investigate the per-formance in orbit of new types of solar cellsa nd of metal oxide semiconductor devices in a space environment.

The UK–6 satellite was designed, built and tested by Marconi Space and Defense Systems, Ltd., of Portsmouth, England, for the Ministry of Defense, Procurement Executive, in London. Technical advice during spacecraft development has been provided by the Royal Aircraft Establishment.

NASA's Office of Space Transportation Systems directs the project.

NASA Delegation Visits China

NASA Administrator Dr. Robert A. Frosch headed a 13-member delegation of U.S. space officials on a recent visit to China. The delegation included NASA officials and representatives of the Office of Science and Technology Policy, the National Security Council, the Department of State, the National Telecommunications and Information Administration, the National Oceanic and Atmospheric Administration and the United States Geological Survey.

The purpose of the U.S. delegation's visit was two-fold: to gain familiarity with Chinese space activities and to have further discussions with the Chinese concerning planned space cooperation. Specifics are: Chinese procurement of a domestic civil satellite communications system, and a ground station for the direct reception of Landsat imagery.

The U.S. delegation met with Chinese space officials in Beijing and toured a number of Chinese space installations. Frosch returned to the United States at the completion of the meetings in Beijing, on June 3.

The U.S. delegation visited China at the invitation of Dr. Ren Xinmin, President of the Chinese

Academy of Space Technology, who headed the Chinese space delegation that visited NASA and U.S. space industry firms at the end of 1978. While in the United States, the two countries reached an understanding on the intended procurement of a domestic, civil satellite broadcasting and communications system and a Landsat ground station. That understanding was additionally formalized in a side letter attached to the U.S.-China Agreement on Cooperation in Science and Technology, signed by President Carter and Chinese Vice Premier Deng Xiaoping on Jan. 31, 1979.

Members of the NASA delegation were: Frosch; Dr. Anthony J. Calio, Associate Administrator for Space and Terrestrial Applications; Dr. William C. Schneider, Associate Administrator for Space Tracking and Data Systems; Dr. William P. Raney, Assistant Associate Administrator, Office of Space and Terrestrial Applications; Dr. Adrienne F. Timothy, Assistant Associate Administrator, Office of Space Science; Kenneth S. Pedersen, Director, International Affairs Division; Dr. Wilfred E. Scull, Director, Peoples Republic of China Program Office, Office of Space and Terrestrial Applications; and Peter G. Smith, international affairs specialist.

Members of the delegation from other government agencies included: Benjamin Huberman, Senior Staff Member, National Security Council and Assistant Director for National Security, International and Space Affairs, Office of Science and Technology Policy; Norman Terrell, Deputy Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs; Dr. John Richardson, Chief Scientist, National Telecommunications and Information Administration; Dr. Clifford Spohn, Deputy Director, National Environmental Satellite Service, National Oceanic and Atmospheric Administration; and Allen Watkins, Chief, EROS Data Center, United States Geological Survey.

Bigger, Better Antenna at California Station

Major modifications to NASA's Deep Space Station Echo antenna near Barstow, Calif., have been completed in preparation for planetary and interplanetary exploration during the next decade.

Modifications consisted of adding the capability to receive signals from spacecraft at X-band frequencies, increasing the antenna diameter from 26 to 34 meters, and installing a new drive system for antenna pointing.

The new diameter enables Station Echo to capture almost twice as much of a spacecraft's signal, to receive data at higher rates, track spacecraft at greater distances, and give partial relief to the overloaded 64-m antennas.

Echo and its two overseas counterparts, still to be modified, will be important participants in the Voyager encounters with Saturn in 1980 and 1981. Through a technique called "real-time arraying," the X-ray signal received by the 34-m antenna will be combined with the signal received by the nearby 64-m antenna. This will make it possible to capture as much spacecraft signal as could be received with a single antenna 71 m in diameter. With more signal received, the spacecraft can send more data. Perhaps this additional data will contain another discovery as exciting as the volcanoes on Io or the ring around Jupiter.

Before the modification of Echo, only the three Deep Space Network stations with 64-m antennas could receive X-band signals. These stations were becoming severely overloaded as more and more spacecraft used X-band. The new frequency permits more images and other data to be transmitted over planetary distances on smaller and lighter spacecraft components.

To prevent the enlarged antenna from hitting the ground, the entire 406,000-kilogram structure was

raised 3 m, while a new foundation was built underneath and then repositioned with an accuracy of 0.13 millimeters.

The new all-electric drives are expected to significantly reduce maintenance while saving approximately 55,000 kilowatt hours of electricity each year.

Instrument on Pioneer Venus Malfunctions

The infrared instrument aboard NASA's Pioneer Venus orbiter spacecraft has been returning degraded data, and efforts to correct the problem have not succeeded. The instrument returned excellent data for 72 orbits of the planet (one orbit per day), enough for a thorough infrared survey of Venus.

The problem appeared on Feb. 14, when the regulated voltages which supply power to the instrument began registering 6 to 7 volts instead of the required 10 volts. The difficulty had occurred even earlier on three occasions, but each time the instrument was reset by ground command with almost no loss of science.

Tests continue to be performed on the instrument and a review board is studying the problem. Experimenter Dr. Fred W. Taylor of NASA's Jet Propulsion Laboratory believes the instrument still may be revived.

During the 72 orbits of nominal performance, the radiometer returned a large quantity of excellent data, including more than 800,000 temperature profile, albedo, humidity and cloud height measurements distributed over the planet. As this information is analyzed, important findings are emerging about the structure, dynamics and meteorology of the Venus atmosphere.

The radiometer science team is very happy with the experiment, Taylor said. In spite of the apparent early loss of the instrument, the team believes results already are far beyond mission objectives.

The Pnoneer Venus mission is managed by the Ames Research Center. The Pioneer Venus orbiter and multiprobe were built by Hughes Aircraft Co. of El Segundo, Calif.

New Computer System in Operation at GSFC

A team of computer analysts from the Computer Science Corp. and engineers from the Goddard Space Flight Center have developed a general ground support equipment system that can realize savings of $30,000–$100,000 per instrument. A GSE is a system to command and control an instrument and to acquire, display, store and analyze data from it. It is a vital system element providing a computerized means for instrument check-out and calibration during the development of scientific instruments and their integration into spacecraft.

The corporation has for the past 2 years been developing this generalized ground support equipment system with the aid of the office of the NASA Chief Engineer. The system first was implemented using an Interdata–7/16 computer, and supported the development of two experiments aboard the ISEE–C spacecraft and several balloon flights originated from the laboratory for high energy astrophysics at Goddard. The system was then implemented using the PDP–11/34 minicomputer. It is now virtually completed and is available to any experimenter within and outside of the NASA community. Final system release documentation will be produced during the current Fiscal Year.

The general GSE system was designed to increase to the maximum the breadth of application to cover a broad spectrum of different instruments as well as support the end-to-end experiment life cycle. To accomplish this, the general GSE system incorporates four highly notable and significant features:

- The system is extremely easy to configure to a particular application because of the extensive use of control tables and the wide variety of compatible hardware peripherals.
- The user interface is a version of the Goddard system testing and operations language (STOL) which can operate in both user on-line or stored procedure modes.
- The GSE software includes a highly sophisticated task scheduling capability which is configurable through use of the STOL language statements.
- The device interface to the controlled instrument uses a standard bus for which there are many off-the-shelf hardware modules by many manufacturers.

In the most general sense, a GSE System combines two principal functions consisting of data acquisition, processing, and display; and command and control.

Consequently, a GSE system is needed for laboratory automation of testing and calibration procedures associated with the development and integration of any instrument with electronic command and data interfaces. The GSE system has a

large number of possible applications and many potential users both in the Goddard environment and at other NASA centers, universities, goverment agencies, and private industry.

Developing GSE software for a given spacecraft instrument may require 2 to 4 man-years, but by using the general approach an experimenter may reduce the development time to 2 to 6 man-months.

The system was presented at a conference on computerized data acquisition held in Santa Fe. A descriptive paper will be read in an ACM meeting in Washington, D. C. in mid-June. In addition, the general GSE system has been demonstrated to several groups from both inside and outside Goddard. High levels of interest have been generated and potential users had been committed to use this system for their particular applicaions.

NASA Featured in Paris Air Show

"Transportation for Tomorrow, Today," a look at the future of air and space activities by NASA, is the centerpiece of the theme area of the U.S. Deparment of Commerce exhibition at the 1979 Paris Air Show. The show opened for the press June 8 and for the public June 9–17.

The U.S. exhibition, staged by Commerce's Industry and Trade Administration, features the latest products and services of 107 American manufacturers of aerospace industry equipment and supplies.

The theme of the display in the U.S. Pavilion is the work of NASA in creating technology that ultimately becomes available for use in the products of the U.S. aerospace and transportation industries. Highlights of the NASA exhibit include a full-scale mockup of the Space Shuttle's cargo bay and a full-scale model of the remotely-piloted HiMAT, a highly maneuverable aircraft technology research vehicle. At the entrance to the pavilion, a five-meter tall replica of the Space Shuttle is displayed. Surrounding the scale model is a graphic display of a Shuttle mission from launch to landing.

A full-scale mock-up of the Space Shuttle cargo bay also is part of the exhibit.

Another exhibit demonstrates the international character of the Space Transportation System. One display features the Spacelab, being developed by the European Space Agency.

NASA research in support of safer, quieter, more efficient and higher-performing aircraft shares the spotlight with the Space Transportation System.

The exhibits covering aeronautical programs include NASA-U.S. industry research and technology developments aimed at reducing fuel consumption by as much as 50 percent in future civil transport aircraft.

NASA research on increased safety includes displays of studies centered on general aviation crashworthiness, stall/spin studies and improved cockpit. Explanations of NASA research programs aimed at airport terminal-area congestion relief, improved all-weather operational capabilities, and engine exhaust pollution reduction are on display. Also featured are NASA studies of advanced cargo, supersonic cruise and hypersonic aircraft concepts, and advanced technology for future aircraft with dramatically increased turning capacity.

JSC Deputy Director Retires

Sigurd A. Sjoberg, deputy director of the Johnson Space Center, retired from federal service effective May 18 after 37 years with NASA and its predecessor, the National Advisory Committee for Aeronautics.

Sjoberg joined OAO Corp. as director and general manager of Houston operations. OAO is an engineering and computer software firm based in Beltsville, Md.

Sjoberg, 59, joined NACA in 1942 as an aeronautical engineer. He holds a B.S. in aeronautical engineering from the University of Minnesota.

His NASA career spanned high-performance aircraft research, manned spaceflight programs, and finally the Space Shuttle. He went to Houston in 1962 when the center was relocated from Hampton, Va. He was named Johnson deputy director in 1972, after serving as director of flight operations for three years.

"I've had as interesting and fruitful career as anyone could hope for," said Sjoberg. "Those years of involvement in our first ventures into space and manned exploration of the Moon are a part of my life that would be hard to match in any other field."

Veteran Launch Expert Retires from NASA

Paul C. Donnelly, who was for 19 years a driving force behind launch programs at the Kennedy Space Center, serving as test conductor, operations manager and associate director for operations in the Mercury, Gemini, Apollo, Skylab and ASTP programs retired in May.

Donnelly, whose last job was director of space transportation systems processing at KSC, is now manager of Florida/California field operations for United Space Boosters, Inc. USBI is the solid rocket booster contractor for the Space Shuttle program and is responsible to NASA for assembly, checkout, launch operations, recovery and refurbishment of the solid boosters and associated components.

His 36-year government career, both military and civil service, has been associated with aeronautics. "I started when the Navy used radar controlled gliders launched from airplanes," recalled Donnelly.

In addition to serving as launch operations manager for many of the manned missions launched from KSC, Donnelly was project manager for the nation's Bicentennial Exposition on Science and Technology held at KSC, and was the approach and landing test manager for ground operations at the Dryden Flight Research Center.

Though Donnelly is retiring from his government career, he will remain a prominent part of the Space Shuttle launch team at KSC.

New Manager for Michoud

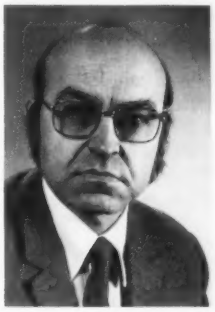
Dr. Mathias P. Siebel has been named manager of the Michoud Assembly Facility in New Orleans, an element of the Space Shutttle projects office at the Marshall Space Flight Center. He succeeds Robert C. Littlefield, who died May 12.

The external tanks which provide propellant for the Shuttle orbiters are manufactured at Michoud by the tank prime contractor, the Martin Marietta Corp. One of the huge tanks will be used in each Shuttle launch.

Siebel has been with the Marshall center since 1965. For the past five years he served on the technical staff of the director of the space sciences laboratory, science and engineering directorate. He was deputy director, and later director, of the former manufacturing engineering laboratory.

Born in Witten, West Germany in 1924, Dr. Siebel earned his Bachelor and Ph.D degrees in mechanical engineering at the University of Bristol in England. He became a United States citizen in 1962.

Naugle Leaves NASA



Dr. John E. Naugle, NASA's chief scientist and former Associate Administrator retired from government service June 29.

Naugle joined NASA in 1959 as head of the nuclear emulsion section at the Goddard Space Flight Center, after working at the Convair Scientific Research Laboratory and the University of Minnesota, at which he received his doctorate in physics in 1953.

In 1961, he spent a year as chief of physics, physics and astronomy programs, in NASA's Office of Space Science. From 1962 to 1966, he was the director of physics and astronomy programs in the Office of Space Science and Applications.

Naugle was appointed Associate Administrator for Space Science and Applications in 1967 and Deputy Associate Administrator for NASA in 1974. He assumed the duties of Acting Associate Administrator in 1975 and later that year became Associate Administrator. In 1977, Naugle assumed the duties of chief scientist.

He is a member of the American Physical Society, the American Institute of Aeronautics and Astronautics and Sigma Xi. Twice, in 1969 and 1977, he received the Distinguished Service Medal, NASA's highest award. In 1976, he was awarded the University of Minnesota's Outstanding Achievement Award.

NASA Administrator Dr. Robert A. Frosch commented on Naugle's career, saying:

"He has been an effective proponent for space, an international negotiator of distinction, a leader and guide to a generation of managers. The country owes him a debt of gratitude for unselfish service to the causes of human knowledge and rational excellence. I and all who know him will miss his practical wisdom and counsel."

The Way It Was

From the Dawn of the Space Era to Apollo 11

A quarter of a million miles from Earth, between a field of boulders and a circle of craters, a small memento commemorates an immeasurable triumph, left there in A.D. 1969 by humanoids from planet Earth. The object is a steel plaque bolted to the landing leg of the U.S. lunar module, the *Eagle*. It bears a two-sided map of of the world and the inscription:

> Here men from the planet Earth
> first set foot upon the Moon,
> July 1969 A.D.
> We came in peace for all mankind

The visitors stayed for less than a day. They walked on substance with no origin in their world, but with 2,000 years of earthly learning compressed in each footprint. When the ascent stage of the *Eagle* flew away, the landing gear and its inscription were left to the stark silence of the lunar surface.

The United States reached that place in eight years. Except that it was the capstone to centuries of speculation and thought, and to the 20th Century explosion of aeronautics and rocketry, manned space flight to a foreign planet was achieved within one decade. The national space agency had accepted a challenge with time and untried technology to meet that deadline.

With the establishment of NASA in 1958, the U.S. space effort became an operational enterprise as well as a system for research and development. That meant launching, operating and tracking vehicles and satellites. The premier program for manned flight was Project Mercury. In the spring of 1961 came the breakthrough—a 15-minute, suborbital Mercury ride by Alan Shepard.

President Kennedy went before the Congress on May 24, 1961, and charged the government and the American people with landing a man on the Moon and returning him safely before the decade was out.

The Moon as the ultimate destination was not a sudden decision. Elements of the Apollo program had been put in motion even before the successful Mercury flights had begun. With the President's mandate, it was official. The space agency was pledged and the clock began running toward 1969.

With its sights on the Moon, NASA had settled on the concept of a lunar rendezvous as the best way of getting there and back. The master plan was to detach a small manned spacecraft from a command craft, make the lunar landing, and then catch up and dock with the mother ship in orbit. To perfect manned operations in space, the Gemini program was created. The Gemini missions, with a two-man crew, showed that astronauts could leave their confined, instrument-crammed positions and perform extra-vehicular activity, including walking in space. Gemini also proved that flights of long duration caused no serious medical problems. And the critical techniques of flight management were refined and perfected in Mission Control, building for the complexities of Apollo.

Four NASA centers were deeply involved in the unprecedented planning: the Marshall Space Flight Center for launch vehicle development; Kennedy Space Center for launch control; Johnson Space Center for operational control; and Goddard Space Flight Center for operation of the worldwide manned space flight network.

Through the mid-1960s, the disparate parts of a gigantic technical undertaking came together, a meld of structures and sprawling facilities, machines and tiny, miniaturized instruments. Buildings went up that were major engineering feats in themselves. Industry and universities joined with government and the military, contractors made components, scheduling led to shipping, a center at a domestic site complemented a deep-space antenna overseas. All the hardware and communications had to synthesize as the decade waned.

Just before Christmas of 1968, Apollo 8 went to the Moon. Astronauts Borman, Lovell and Anders became the first humans to leave the Earth and enter the gravitational control of another solar body. Captured in a lunar orbit, they were the first to see the unknown back of the Moon and to track its lonely wasteland. Apollo 8 came home to estatic receptions and the last year of the 1960s had arrived.

By July of 1969, the Apollo program had accelerated to the point where NASA was prepared for the first formal attempt to land men on the Moon. The conclusive push came from the performances of Apollo 9 and Apollo 10. The two missions, in March and May, had verified in space the command and service modules and the LM—lunar module. Astronauts and equipment had gone through all phases of a collective dress rehearsal. They had done

everything but touch down on the lunar crust, stay there, and lift off to reunite as one vehicle for the return to Earth.

Apollo 10 floated down in the Pacific on May 26. The huge Saturn V rocket designated to launch the Apollo 11 spacecraft was already in position on Pad 39-A at the Kennedy Space Center. Countdown was begun, found all systems favorable and ended on the eve of the 4th of July. The next launch window was dependent on light conditions at the planned landing site, the Moon's Sea of Tranquility, and the window would open at 9.32 a.m. EDT on July 16. The commitment was made to launch then.

The commander of Apollo 11, Neil Armstrong, described that morning:

"All was ready. Everything had been done. Projects Mercury and Gemini. Seven years of Project Apollo. The work of more than 300,000 Americans. Six previous unmanned and manned Apollo flights. Planning, testing, analyzing, training. The time had come.

"We had a great deal of confidence. We had confidence in our hardware: the Saturn rocket, the command module, and the lunar module. All flight segments had been flown on the earlier Apollo flights with the exception of the descent to and the ascent from the Moon's surface and, of course, the exploration work on the surface. These portions were far from trivial, however, and we had concentrated our training on them. Months of simulation with our colleagues in the Mission Control Center had convinced us that they were ready.

"Although confident, we were certainly not overconfident. In research and in exploration, the unexpected is always expected. We were not overly concerned with our safety, but we would not be surprised if a malfunction or an unforeseen occurrence prevented a successful lunar landing.

"As we ascended in the elevator to the top of the Saturn on the morning of July 16, 1969, we knew that hundreds of thousand of Americans had given their best effort to give us this chance. Now it was time for us to give *our* best."

Apollo 11 lifted off in a classic launch, precisely on time. Eleven minutes later, Armstrong and his crew of Edwin E. Aldrin and Michael Collins were in Earth orbit. In less than three hours, the Saturn was fired and the preprogrammed escape from Earth completed; they were on their way to the Moon.

On the fifth day of the mission, their spacecraft circling the Moon at 60 miles altitude, Armstrong

Launch View from the Beach—Sea and shoreline have not changed noticeably since 1963, when this was the way a gantry looked, embracing a NASA spacecraft (Artist: John W. McCoy, II).

Pre-launch Exam—All astronauts—in the early days and in the future—undergo medical tests designed to reveal any last-minute physical difficulties (Paul Calle).

and Aldrin entered the LM and separated from the command module *Columbia,* leaving Collins alone in orbit. It was July 20. The descent, controlled by engine burns, took the astronatus to the surface in two and one half hours. At 4:18 p.m. EST, Neil Armstrong broke the tension: "Houston, Tranquility Base here, the Eagle has landed."

After hours of checkoff, Armstrong squeezed through the LM's hatch and moved slowly down the ladder. At 10:56 p.m. he said, "That's one small step for a man, one giant leap for mankind." Neil A. Armstrong, 38, of Wapakoneta, Ohio, stood on another planet.

Armstrong set up a television camera and examined the fine-grained soil beneath his feet. Less than 15 minutes later, Buzz Aldrin followed him to the ground. Hundreds of millions of people saw the two astronauts in their bulky suits as they plodded around the grey surface, performing their assigned tasks. The next day, with their scientific experiments deployed and rock samples collected, Armstrong and Aldrin blasted off to rendezvous with the command ship in orbit. Just before docking, as he watched the LM's approach, Mike Collins remembers thinking, "for the first time on this incredible flight I feel it is going to happen . . . we are a long way from home but from here on it should all be downhill . . . we are really going to carry this off."

The carrier *Hornet,* with recovery helicopters and divers, was waiting southwest of Hawaii. On the afternoon of July 24, Apollo 11 splashed down in the South Pacific. More than one-fifth of the world's population had watched the Moon landing sequence, at least half the world knew about it. Excitement was worldwide for an event in the saga of mankind that seemed to transcend nationality. But for Americans, Apollo 11 also left a feeling of renewal in the national spirit. Years of war, assassination and domestic chaos could not diminish the shining moment. It was a good end to a bad decade.

In the ensuing 10 years, NASA had built upon the epoch of Apollo 11 with its affirmation of American vision and competence. Subsequent lunar landings, then the close of the Apollo program and reduced budgets only turned the agency to new directions. The manned flights of Skylab and Apollo-Soyuz were followed by the exploration of Mars, the Venus probes and other planetary investigations. Parallel advances in the satellite system brought expanded and cheaper world communications, astronomical discoveries, remote sensing techniques with the potential of managing world resources. All these projects signified the permanent status of man in the space environment. They contributed to the next evolutionary step—the Space Shuttle.

In the 1980s, the Shuttle will operate as the common carrier of space transportation. Spacecraft and launch equipment are returnable and reusable. The multiple payloads in the cargo bay can be placed where wanted and picked up or repaired in orbit. Besides scientific experiments, the Shuttle will allow for manufacture and in time, may precipitate structures in space. New programs are certain to grow from the routine findings of others.

Of all the Shuttle aspects, the human progression may be the most remarkable. Peoples of the world are going to be accommodated and made to feel at home in space, not just astronauts and cosmonauts, but average beings, willing to leave their planet for brief or extended periods.

The missions that came after Apollo proved that humans can live comfortably and work productively in space for long spans of time. And in all historical and scientific narratives, and in the annals of courage, July 20, 1969, will defer to the few who were first.

. . . the View from the Kennedy Space Center

July 16, 1969 was a beautiful morning at launch complex 39—bright sunshine, a few fleecy clouds . . . and very warm. As the sun marched up the eastern sky, a light breeze wafted in from the nearby Atlantic, ruffling the flags behind the wooden bleachers at the viewing site north of the huge Vehical Assembly Building and cheering the assemblage of 5,000 special guests.

They had gathered at the Kennedy Space Center from all over the nation and the world—heads of state, political figures, diplomats, scientists, judges, religious and military leaders, corporate executives, sports and screen celebrities.

Close by was the press corps, 3,500 strong, representing 56 nations, including three Iron Curtain countries. Thousands of NASA civil service and contractor employees and their families lined the perimeter roads of the complex. And miles away, jamming the riverfronts, beaches and highway approaches to the space center, were a million visitors, estimated to be the largest crowd in history to witness a single event.

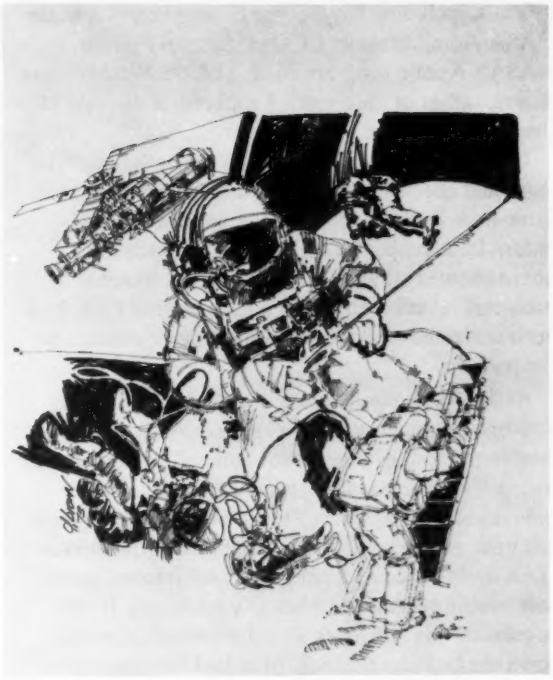
They had come—the invited and the uninvited—to see the start of the most daring voyage of explo-

ration ever attempted . . . man's first journey to the surface of the Moon. The time was 9:26 a.m., six minutes before liftoff, and all eyes were riveted on the gleaming white Saturn 5 rocket and its bright orange launch tower silhouetted against the pale blue Florida sky.

Atop the 36-story-tall rocket, the Apollo 11 astronauts were making last-minute checks of their spacecraft. In the left seat was Commander Neil Armstrong, civilian and ex-test pilot. Next to him was Lunar Module Pilot Edwin "Buzz" Aldrin, a colonel in the Air Force. Occupying the right seat was Command Module Pilot Michael Collins, an Air Force Lieutenant colonel. All three had flown in space before. Each was born in 1930, each weighed 165 pounds and the three were within an inch of the same height—five feet, eleven inches.

They had started the day at 4:15 a.m., after being awakened by Flight Crew Director Deke Slayton, also an astronaut. Following a breakfast of orange juice, steak, scrambled eggs, toast and coffee, they suited up and departed for Pad 39A, arriving after fueling operations had been completed. Armstrong entered the Apollo at 6:45 a.m., assisted by the six-man pad closeout crew under the direction of Rockwell International's Gunter Wendt and NASA's Spacecraft Test Conductor "Skip" Chauvin. Collins entered next, followed by Aldrin. Before leaving the pad at 8:32 a.m., the closeout crew shut the hatch, pressurized the cabin to check for leaks and purged it. For Armstrong, Aldrin and Collins, the lonely vigil had begun. They would not gaze upon other human face until splashdown in the Pacific Ocean eight days later.

Three and a half miles away, in the control center, launch director Rocco Petrone and his 463-man Apollo launch team monitored the final minutes of the countdown. Petrone directed the operation from his command station in "management decision row" which looked out over row on row of flashing consoles and recording racks manned by engineers and technicians of the space agency and its major Apollo contractors—Boeing, Rockwell International, McDonnell Douglas, IBM, General Electric, Grumman, Rocketdyne and Aerojet General. Seated alongside Petrone were Dr. Kurt Debus, director of the Kennedy Space Center; Dr. Hans Gruene, the center's director of Saturn 5 operations; and Dr. George Low, Apollo program manager for the Johnson Space Center in Houston. Observing the countdown procedures were NASA Administrator Dr. Thomas O. Paine and other high level NASA



Astronauts in Composite—They all went through similar experiences in the 1960s and so will the next set of astronauts in the 1980s (Don Brown).

Hundreds of Press People Were Everywhere—At times almost murderous jockeying for position took place as spacecraft blasted off (Fred Freeman).

officials, including Dr. George E. Mueller, Associate NASA Administrator; Lt. Gen. Samuel Phillips, NASA's Apollo program chief; and Dr. Wernher von Braun, father of the Saturn 5 rocket and director of the Marshall Space Flight Center.

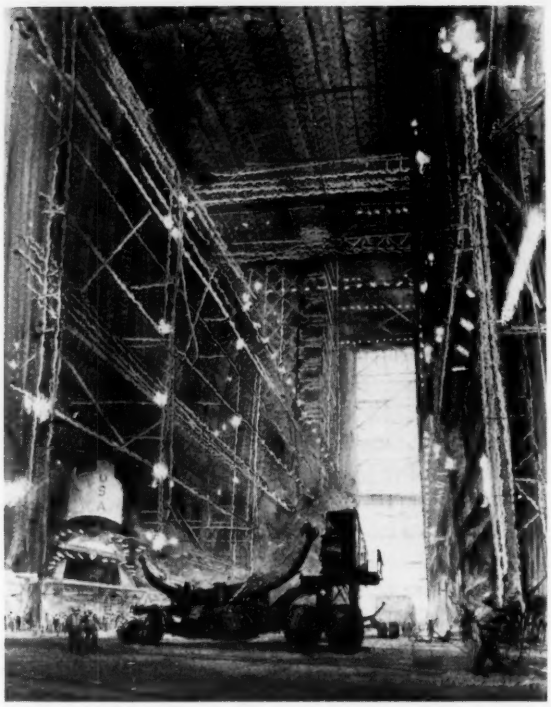
Over the previous dozen hours or so, the launch team had checked off thousands of items form the three-inch-thick coutndown manual, the bible of Saturn launch operations. The huge launch status board showed all green. Two minor equipment problems, a leaky valve and a faulty signal light, had been corrected while the astronauts were enroute to the pad.

At 9:27 a.m., or T-5 minutes, the Apollo access arm on the launch tower was retracted. At the four-minute-mark, the "cleared for launch" command was issued. The countdown became automatic at 3 minutes and 20 seconds. Things were happening too fast now, racing beyond the capability of the human mind. Only computers, with their millisecond quickness, would be able to detect any problems. If one developed, the machines would automatically shut down the launch sequence. Man had become a bystander.

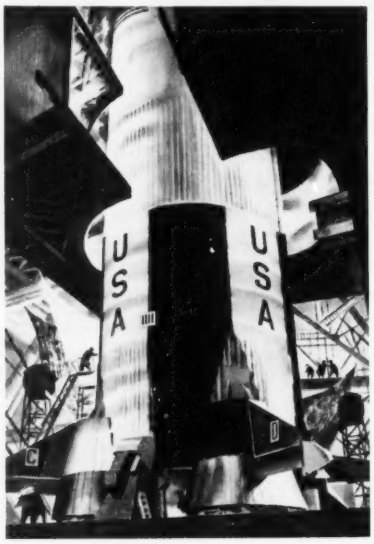
T-15 seconds. All attention was centered on the launch pad. On the beaches and the road, on boats anchored in the surrounding waterways, spectators raised their binoculars. At the VIP bleachers, everyone stood. Newsmen with direct phone lines opened to their papers in New York, Paris, Tokyo and thousands of other cities around the world, were describing the final moments. All U.S. networks had cameras focussed on the massive Moon rocket. Everywhere, for a distance of 75 miles, hundreds of thousands of people waited and watched. Fingers were crossed, rosaries kissed, breaths held.

Half a mile from the launch pad, protected by a sand bunker, 14 rescue workers stood watch. Equipped with armored personnel carriers, and wearing flame protection gear, they would move in quickly to assist the astronauts in case of an emergency. Manning special roadblocks surroundings the complex were teams of doctors, nurses, safety officials, ordnance experts and recovery specialists—prepared to spring into action if the Saturn 5 exploded on the pad. Loaded with nearly 3,000 tons of volatile fuel, an exploding Moon rocket would shatter with the force of 1.2 million pounds of TNT.

High in the Apollo command module, the astronauts gripped the armrests of their couches . . . ready, if necessary, to trigger the launch escape

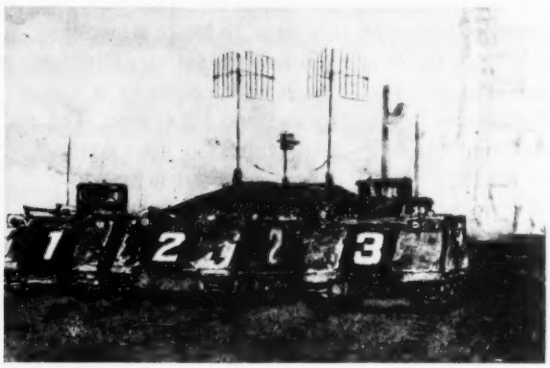


Spacecraft "Garage"—At the Kennedy center, the enormous Vehicle Assembly Building shelters outward bound spacecraft until they are moved out to the launch pad (Nicholas Solovioff).



Almost Ready for the Moon Mission—Apollo 11, its upper portion rising to the upper reaches of the 40-story VAB, ready to be moved to the launch site (Mario Cooper).

Suited Up for Space Travel—Apollo astronauts ready to climb into their spacecraft (Paul Calle).



Rescue Squads—Ready to rush to the aid the astronauts in case of an accident, rescue vehicles line up near the Apollo 11 launch site (James Wyeth).

Apollo 11 Crew—Astronauts Aldrin, Armstrong and Collins on the morning of the first flight to the Moon (Paul Calle).

tower atop Apollo which would pull free of the rocket and parachute them back to earth some distance from the pad. Firemen and medical specialists would speed to the scene in moments, carried aboard helicopters and amphibious vehicles.

At 8.9 seconds before liftoff, the five first-stage engines of the Saturn 5 erupted like inverted volcanoes, spewing fire and smoke down the huge flame deflector at the base of the pad. Sheets of ice that had formed on the rocket's skin by the freezing propellants inside flaked off in a storm of white. Shock waves pounded the flat oceanfront, filling the sky with flocks of duck, heron and small birds. Seconds later, the throbbing thunder enveloped the thousands of spectators several miles away. Some gasped in awe. Others clapped their hands over their ears to shut out the near-deafening roar.

At T-0, the engines had built to full thrust of 7.5 million pounds, the equivalent of 180 million horsepower, and the computer signalled the holddown arms to release the vehicle. An instant later, the remaining swing arms connecting the rocket to the launch tower swung back. At 9:32 a.m., EDT, the 363-foot, 6.5-million-pound behemoth rose in a brilliant fireball.

"Liftoff! We have liftoff!" blared the loudspeakers.

Cheers rang out in the KSC control room as the Saturn 5 slowly gained momentum.

"Go baby, go," someone shouted. At the guest site, people cheered, some of them in tears, as they watched the flaming rocket climb to unearthly heights, finally escaping gravity and roaring into space, its destination the Moon.

. . . Vindication for the Dreamers at Huntsville

The goal set by the late President John F. Kennedy On May 25, 1961, to put man on the Moon, lit a torch under a fast-moving development program which produced, in only six years, the most powerful rocket known to mankind—the gigantic Saturn V.

July 20 marks the 10th anniversary of the first lunar landing. The Saturn V rocket that provided the power for this feat was developed by the Marshall Space Flight Center, under the leadership of the rocket pioneer Dr. Wernher von Braun.

Groundwork for Saturn had been laid by the group at Marshall years earlier when it was still part of a U.S. Army agency at Redstone Arsenal. Even before joining NASA in 1960, the group had started clustering propellant tanks and engines to make bigger rockets from existing liquid fuel vehicles. The result was the Saturn I, the first member of what was to become a distinguished family of rockets.

The requirement for a launch vehicle capable of propelling a manned spacecraft all the way to the Moon called for bigger drawing boards and more help from the aerospace industry, educational and research institutions and hundreds of thousands of individuals.

Many decisions had to be made in a hurry, such as the procedure for getting to the Moon and back and the type of launch vehicle to be used. After months of intensive consideration of various options, NASA had made its basic decisions: "Lunar Orbit Rendezvous" was to be the method and Saturn V the vehicle.

Saturn V would have five of the new F-1 engines, each developing some three-quarters of a million kilograms of thrust, in the first stage—for a total liftoff thrust of 3.1 million Kg. Its second stage would have five J-2 engines, each developing 45,000 kg of thrust, and the third stage would be powered by one J-2 engine.

The Kennedy Space Center (then the Launch Operations Directorate of the Marshall center) was responsible for assembly of launch vehicle stages, the mating of spacecraft with launch vehicles, and conducting checkout and launch operations.

The Johnson Space Center (then the Manned Spacecraft Center) was established to handle development of the Apollo spacecraft, training of the crews and control of the missions.

Building the Saturn V was to be a team effort all the way, with thousands of companies and scores of thousands of workers participating.

Marshall issued a contract to the Boeing Co. to produce the first (S-IC) stage, to North American Aviation's Space and Information Systems Division for the second (S-II) stage, and another to its Rocketdyne Division for F-1 and J-2 engines. The McDonnell Douglas Astronautics Co. got a contract for the third (3-IVB) stage and another went to International Business Machines Corp., Federal Systems Division, for the rocket's instrument unit.

Thousands of other contracts were issued by Marshall and its major contractors for the millions of items needed to build the giant rocket, for building checkout and test facilities and for providing means of transporting the huge components.

A large plant at New Orleans, earlier used for the manufacture of tank engines, was reopened for use by

Boeing and Chrysler corporations. (Chrysler was building the first stages of the Saturn 1B, an updated version of Saturn I that was a stepping stone to the Saturn V.) This plant became known as Michoud Assembly Facility.

A tract in and surrounding Hancock Country, Miss. was acquired, about 850 families in five communities were moved and resettled, and an engine test site was built—the Mississippi Test Facility (now NASA's National Space Technology Laboratories). The central test area occupied 5,454 hectares and the buffer some 51,712 surrounding hectares.

At Slidell, La., near both the new test site and the Michoud plant, a structure built originally for the Federal Aviation Agency was occupied, remodeled and stocked with digital and analog computers. The Slidell Computer Complex served in test, checkout, simulation and engineering activities.

The Marshall center manufactured the first four S-IC stages of Saturn V, two for testing and two for flight. All other first stages were fabricated at Michoud.

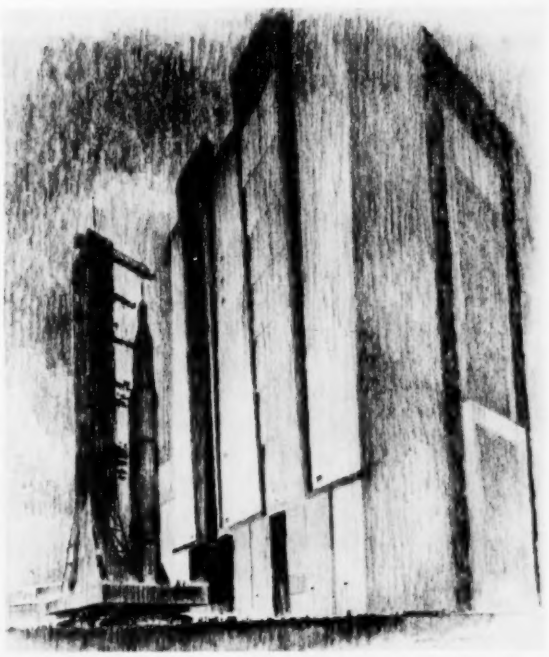
Principal engine testing activities were conducted in California by the builder of the engines, Rocketdyne, while the Mississippi facility was under construction. Also during this time the Marshall center test-fired F-1 and J-2 engines and the "battleship" S-IC stage in its own Huntsville, Ala., test laboratory.

Once the Mississippi test site was operational, first and second stages of Saturn V were placed in the giant new stands and test-fired in Mississippi. They then were shipped by barge to the Kennedy center. The third stages, following testing at the Sacramento facility of McDonnell Douglas, were flown to KSC aboard the unique "super guppy" aircraft, a modified Boeing Stratocruiser.

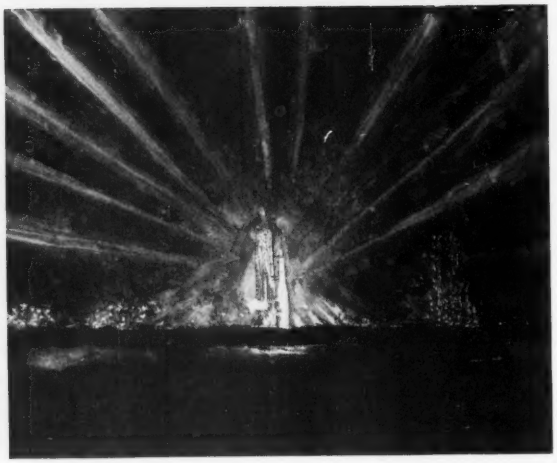
Development of Saturn V posed problems of magnitudes never before faced by engineers—requirements for such great size, weight, strength, power and capability that no "textbook" references existed. The vehicle, with spacecraft attached, would be longer than a football field, have a base diameter greater than the combined widths of three tractor-trailer rigs, weigh more than a light Navy cruiser and develop more power than a string of Volkswagens stretching from New York to Seattle. Five turbopumps with a total strength of 30 diesel locomotives would force some 14 metric tons of fuel per second into the five F-1 engines, which would burn 19 million kg of propellants in two and one-half minutes. Everything from rivets and stringers to rocket engines and stages, had to meet exacting standards to provide the reliability necessary for unmanned space flight. Suitable materials were found or developed and exacting manufacturing techniques were developed to solve all problems and fill all needs.

Many today believe that one of the greatest challenges of the Apollo-Saturn program was the development of a new and extraordinary management approach that allowed NASA to involve vast human and material resources in working toward a common goal. The system developed to meet the incredible complexities of the program provided the United States with a pattern for managing a broad number of future technological, scientific and social endeavors.

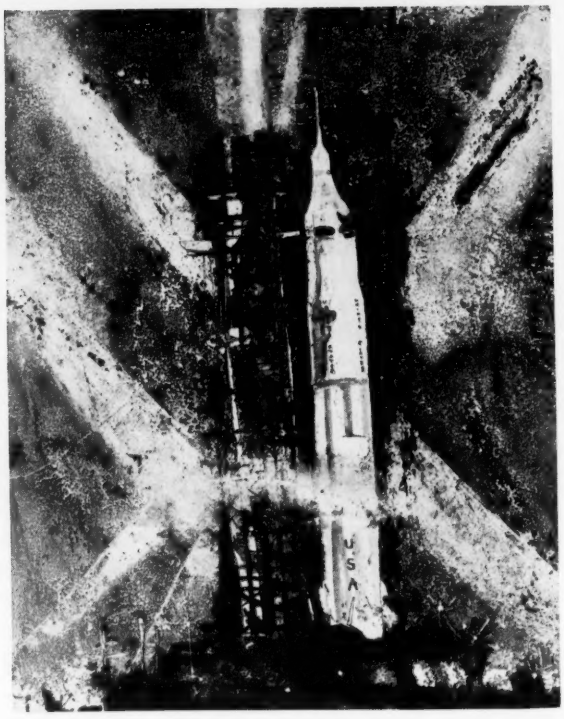
On Nov. 9, 1967, the first Saturn V—110 meters tall, including spacecraft, costing $180 million—sat ready for liftoff from the Kennedy center. Saturn V kept its makers and watchers waiting only one second beyond the appointed moment of liftoff, then rose majestically with an awesome roar. It climbed past the launch tower, picked up speed, bored into the sky and arched smoothly into its trajectory. In a few moments it was gone—a first launch that was a grand success.



Rollout—Apollo 11 seen as it left the VAB, headed for its rendezvous with history (Mario Cooper).

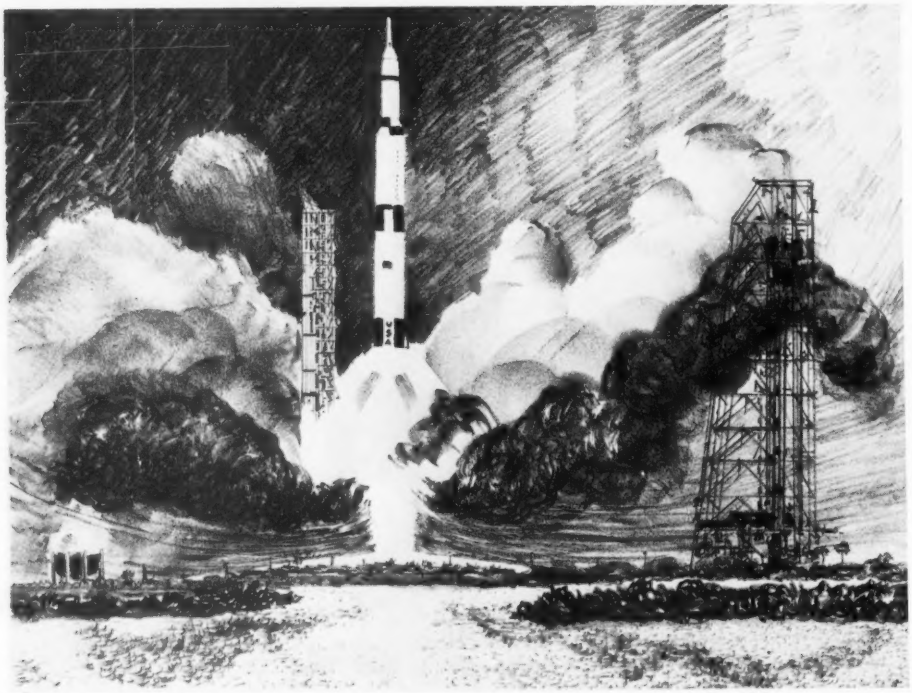


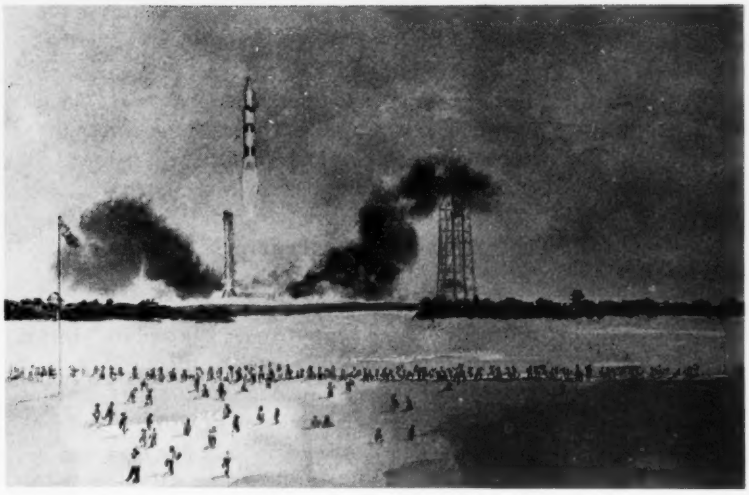
On the Fateful Morning—Sunrise seems to form a frame for Apollo 11 at daybreak, July 16, 1969 (James Wyeth).



Waiting—Apollo 11 looks poised and ready for its fiery awakening, on the morning of its Moon flight (William Thon).

This Was the Moment—After a decade of preparation, Apollo 11 is on its way (John Meigs).





The Peak of Excitement—Hundreds of thousands of spectators at the Cape were electrified as Apollo 11 began its climb toward the Moon (John Meigs).

. . . How It Was in Houston

Lunar module *Eagle* skimmed down across a cluster of large boulders, its spidery legs seeming to reach out to trip over the obstacles. In *Eagle's* cramped cabin, Neil Armstrong steered the spacecraft toward an open flat patch of Moonscape while Edwin "Buzz" Aldrin called out velocities and heights as surface dust swirled into view.

Aldrin's voice had a trace of concern as he radioed to Mission Control Center-Houston, "1201 alarm!" interspersed with other information he was relaying to Armstrong. A few seconds later he added, "1202 alarm." *Eagle's* computer was being fed landing radar information faster than it could digest it—or so it seemed as the overload alarm digitals blinked into Aldrin's displays.

"Disregard alarms, Flight!" said guidance engineer Stephen Bales from his console front-row right in the Control Center. Bales (call-sign "Fido")) repeated assurances that the computer alarms aboard *Eagle* were spurious signals, and spacecraft communicator (CapCom) Charles Duke radioed reassurance across the quarter million miles, *"Eagle,* looking great! You're GO!"

Eagle's four round talons touched the surface, a blue "Lunar Contact" light came on in the cabin, and Armstrong's words came across the void of space: "Houston, Tranquility Base here. The *Eagle* has landed!"

The rest of the first human venture upon another celestial body became history in the next several hours, and after the Apollo 11 crew returned to Earth there were parades and public adulation and goodwill tours.

There were no laurel wreaths for flight controllers in Mission Control Center-Houston though, for they immediately began training for the next lunar landing, Apollo 12, and for five more manned flights to explore the Moon.

Now, ten years later, many of those same flight controllers are doing the same kind of job at NASA's Johnson Space Center, while others have gone on to other careers in and out of NASA.

Stephen Bales, whose urgings to ignore *Eagle's* computer alarms helped avoid a possible abort, is now chief of the guidance and propulsion branch of JSC's flight control division. His number-one boss ten years ago, Flight Operations Director Christopher C. Kraft, Jr., became director of the Johnson center in 1972.

Guiding the Apollo 11 Descent—The attention of everybody in the Mission Control Center at Houston was riveted on instruments showing the progress of Aldrin, Armstrong and Collins as they guided their spacecraft down to the Moon surface (Franklin McMahon).

Leading the teams of Apollo 11 flight controllers were flight directors Clifford Charlesworth, Gerald Griffin, Glynn Lunney, Eugene Kranz and Milton Windler. Griffin is now deputy director of the Kennedy Space Center in Florida after serving for a period as congressional liaison at NASA headquarters in Washington, D.C., and as deputy director of another NASA center, Dryden Flight Research Center in California.

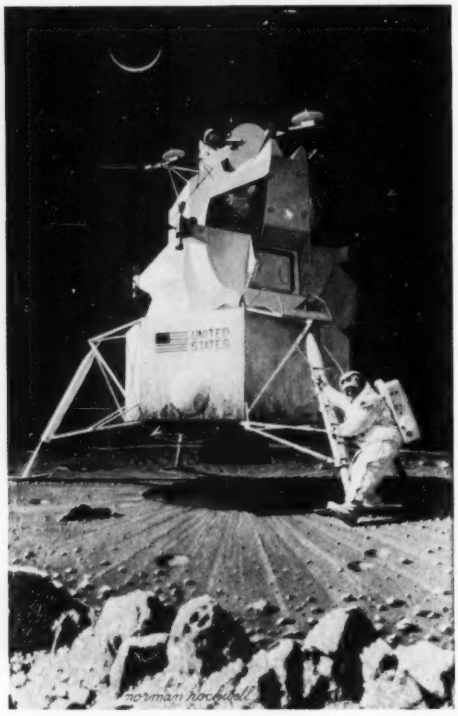
Lunney is now manager of the JSC office that develops payloads for the upcoming Space Shuttle system, and Charlesworth is his deputy. Windler is now assigned to JSC's Shuttle orbiter project office, working in space payload handling systems, such as the remote manipulator system. Kranz now mans a desk instead of a console, as deputy director of flight operations.

"Roger, Tranquility, we copy you on the ground. You've got a bunch of guys about to turn blue. We're breathing again." CapCom Charles Duke so acknowledged Armstrong's first call from the surface of the moon. Duke later walked on the surface of the moon during Apollo 16. He returned to desk jobs at JSC before leaving to run a San Antonio dealership for a Rocky Mountain beer. Duke now lives in the central Texas town of New Braunfels and is in the investment business.

Another Apollo 11 CapCom, Harrison H. "Jack" Schmitt, also later walked on the Moon during the final lunar landing and now holds a seat in the U.S. Senate from his home state of New Mexico.

The ghosts of missions past peer down from the Control Center wall in the form of flight insignia plaques, traditionally hung there at the moment of each splashdown.

A replica of the United States flag and staff thrust by Armstrong and Aldrin into the Moonsoil at Tranquility Base was raised in the Control Center at the same moment and mounted near the projection plotboards. That replica Apollo 11 flag later was carried to Taurus-Littrow scientific station on the Moon by Gene Cernan and Jack Schmitt as they trekked across part of the Moon for what probably will be mankind's final visit during this century. (*Editor's note: Paintings are part of the NASA art collection.*)



First Step on Moon Soil—"The Eagle Has Landed," the words spoken by a jubilant Neil Armstrong, reverberated throughout the world (Norman Rockwell).

Space Chores—The astronauts had to move fast during their short stay on the Moon, collecting samples of everything they could carry (Pierre Mion).

At Splashdown—The crew of the U.S. carrier *Hornet*, eagerly awaiting the safe return of the Apollo 11 astronauts, cheered wildly as the descending capsule appeared in the sky just before landing in the South Pacific. The great mission was finally completed in one of the most triumphal national celebrations in modern history (Mitchell Jamieson).

Presidential Assistant Discusses SES

The subject of a recent address by Stuart E. Eizenstat, Assistant to the President for Domestic Affairs and Policy, before senior officials at the U.S. Department of Labor, was the newly established Senior Executive Service. Among other things, Eizenstat said:

"You are now approaching the beginning of your 90-day open period for joining the Senior Executive Service. This is the best and easiest time for you to make a decision to enter the Senior Executive Service and I realize it is an important career decision for you and for your families. It is not something you take lightly, and I want you to understand that I am not saying what I have to say lightly either. It is much easier, obviously, for me to tell you what to do, when I do not have to live under the system.

"The most important change in the civil service system since its inception in 1883 was the law passed last year. Unquestionably we have a very fine group of Federal employees. We realize that each of you and your counterparts in other agencies work hard, that you're dedicated, that you have talent, and that you have energy.

"Our argument was not that civil servants themselves had to be changed, but that the system under which they operated had to be changed. We faced a system that had outmoded hiring practices, that inadequately protected the rights of employees, that gave management insufficient flexibility, and most importantly and at the core of the problem, provided insufficient incentives for good performance and insufficient disincentives for poor performance. The good employee, the productive employee, the dedicated employee and the poor employee were often in lock step. And it is those things which we sought to change with civil service reform.

"There is no question but that this change responds to a deep-felt need on the part of the American people to have a government which is more efficient, less costly, and has less red tape.

"At the core of civil service reform is the Senior Executive Service. Civil service reform, in my estimation, will be made or undone by how well the SES concept works. So I come therefore, to urge you to join it . . . because it is critical to making civil service reform work and therefore making government work for people, which is one of this Administration's foremost objectives. And secondly, because it's important for you.

"It will create a more efficient and more productive Federal service that is better able to deliver human services and therefore it will be important to the people of this country.

"It offers important financial rewards. Many, perhaps all of you, have a pay cap now which continues to restrict the levels of management salary and has caused others to move into more lucrative private sector jobs. In the Senior Executive Service, a higher basic salary is possible. As of October 1, 1979, the $47,500 pay cap is automatically lifted, and SES members will be able to receive up to $52,800. So the first advantage is that you have a higher base salary to which you can aspire.

"There is a bonus system created which will be available for up to half of those who choose to enter the Senior Executive Service. Those bonuses may amount to up to 20 percent of basic salaries, so on top of having a higher base to operate from, potentially you will also have the possibility of a substantial bonus.

"In addition, a certain percentage can receive an annual stipend—five percent of the SES can receive $10,000 and one percent $20,000, for truly distinguished service.

"So these three components—the basic pay, the bonus, and the special service awards—can allow SES career members to earn a maximum compensation equal to that of an Executive Level I Cabinet Member, $66,000 or $69,600 come October 1. Thus the first reason for joining the SES is purely financial.

"Secondly, you will have a more sophisticated, and we believe, fairer evaluation of your performance. You will know in advance the criteria for job performance at the beginning of your job and your accomplishments can be measured against those concrete goals and objectives.

"Your job performance will be evaluated at least once a year by a panel, and if you are a career executive a majority of the panel must be career executives as well.

"Thirdly, you will have much greater opportunity within your agency to take on more challenging and responsible assignments. If an agency head determines that your talents can best be used to manage other parts of an agency, you can be moved there to greater responsibilities simply and quickly. Placement will be based on talent and agency need.

"In addition, and I am particularly envious of this, Senior Executive Service members will be eligible for sabbaticals. If they have been in the Government

for seven years and for two years in the SES, an executive can spend up to 11 months outside the Federal Government sector in a challenging assignment. And the Office of Personnel Management and your agency will be providing additional training for any executive who determines that it will be useful.

"Beyond this, all executive positions open up to career employees. Since career tenure is personal and portable and not locked into any one job, a career SES member, as most of you will be who join, can even leave the Senior Executive Service to take a Presidential appointment, such as an Assistant Secretary or a Cabinet Secretary slot, and be guaranteed an SES position when that Presidential appointment ends.

"Fourth, you will have strict protection against the politicizing of your positions. I want to stress that when we developed this legslation we wanted to make sure that the Senior Executive Service was not a service designed to reward political appointees. We put a 10 percent statutory limit on the number of non-career appointees for the first time, and we made sure that only career executives in the SES will be eligible for bonuses and the service awards.

"The bill has much greater protection than ever before to protect so-called whistleblowers, people who are complaining about mismanagement, fraud, and abuse within their own agencies. And, with Congress, we have created an independent, apolitical Merit System Protection Board, which will rule on allegations of political abuse. All these were designed to make sure that we not only corrected some of the problems which Watergate uncovered, some that were going on with the civil service, but to make sure that you were fully protected within the Senior Executive Service.

"So let me conclude by saying that civil service reform itself is vitally important to the Country. It is a very, very high priority with the President. He spent as much time on it last year as almost any domestic piece of legislation. The Senior Executive Service is at the core of civil service reform. You and your families can benefit financially and in terms of career enhancement if you join the SES. It needs people who are willing to risk the challenges of greater responsibility and closer evaluation and reap the rewards of a job well done. You would be serving our nation well by participating in the newly established service."

New Associate Administrator Appointed

Dr. Thomas A. Mutch was appointed NASA Associate Administrator for Space Science on July 1, 1979. He comes to NASA from Brown University, Providence, R.I., where he was professor of geological sciences. Mutch has been associated with Brown since 1960, as associate dean of the graduate school and chairman of the department of geological sciences.

As a member of the Lunar Sciences Review Board from 1969 to 1973, Mutch has been a major contributor to NASA science programs since 1969. He was leader of the Lander Imaging Science Team for the Viking Project (1969–1977), chairman of several NASA committees planning the post-Viking exploration of Mars, co-chairman of the Second International Colloquium on Mars which was held at the California Institute of Technology in January 1979, and a scientific investigator on many occasions.

He received the NASA Medal for Exceptional Scientific Achievement in 1977, and NASA group achievement awards for lunar science, Viking science and the Viking undergraduate intern program.

Born Aug. 26, 1931, Mutch graduated from Princeton University in 1952 with an A.B. in history. He earned his M.S. in geology in 1957 from Rutgers University and his Ph.D. in geology in 1960 from Princeton. He was named a Fellow of the Geological Society of American in 1973. He also is a member of Sigma Xi and the American Association for the Advancement of Science. A mountain climber, he has visited the Himalayas twice, most recently during the summer of 1978 with a Brown University group.

Former NASA Official Wins Important Award

Dr. Frederick Seitz, former chairman of NASA's Space Program Advisory Council, received his second NASA Distinguished Public Service Medal in May at ceremonies held at headquarters. Administrator Robert A. Frosch made the presentation. Seitz, President Emeritus of Rockefeller University, New York City was awarded the medal:

"For dedicated service as chairman of the NASA Space Program Advisory Council (1973–1977) and as a respected counselor to the NASA Administrator

and his associates. The guidance and constructive criticism provided by the Council under his leadership were of significant value during the period of transition from the Apollo era to the unfolding era of routine space operations."

A native of San Francisco, Seitz received his B.A. from Stanford University and his Ph.D. in physics from Princeton University. He was also a Proctor Fellow at Princeton.

Before his work for NASA and Rockefeller University, Seitz was the first full-time president of the National Academy of Sciences; a research professor, director, dean and vice president for research at the University of Illinois; a professor at Carnegie Institution of Technology and the University of Pennsylvania; a research physicist at General Electric Research Laboratories; and an instructor and assistant professor at the University of Rochester.

He has been a member of the President's Science Advisory Committee, a member, vice chairman and chairman of the Defense Science Board, member of the Statutory Visiting Committee for the Department of Commerce and a member of the Scientific Advisory Group of the Office of Aerospace Research for the Air Force.

Seitz won the NASA Distinguished Public Service Medal in 1969; the Herbert Hoover Medal for Distinguished Service in 1968, the DoD Distinguished Service Award in 1968, and the Franklin Medal in 1965. He also has earned a number of honorary doctorates.

Goddard Man Receives National Award

James F. Lynch, deputy chief of public affairs at the Goddard Space Flight Center, has won the Aviation/Space Writers Association (AWA) Public Information Award "for the top U.S. Government Information Officer during 1978."

The Association citation says, "This award is for your consistently high performance in managing the national and international news programs of NASA flight satellite programs . . . our Association's highest recognition of outstanding achievements by a Government Information Services Officer in the interest of the aviation/space programs of the military or government services."

Lynch received the award, a framed citation from AWA and an engraved commemorative sterling silver plate sponsored by the Grumman Corp. at a luncheon held at the Shamrock Hilton Hotel, Houston, Texas.

Lynch has been deputy public affairs officers at Goddard since 1971, having joined NASA and the Maryland space center in 1963. Before that, he was public relations representative with Martin-Marietta Corp. at Cape Canaveral, Fla. He served as an information officer, Lieutenant (j.g.), with the U.S. Navy at the Pacific Missile Range, Point Mugu, Calif., from 1957–60 where he first became associated with the space program. He handled press relations for supersonic aircraft, air-to-air and air-to-ground tactical missiles as well as intercontinental ballistic missiles. He served as a civilian information officer with the Navy for two years after being released from active duty.

Lynch was graduated from Loras College in Dubuque, Iowa in 1957 receiving a B.A. degree in economics. Following graduation, he attended the Navy's Officer Candidate School in Newport, R.I., where he was commissioned Ensign.

Veteran Astronaut Resigns from NASA

Astronaut Fred W. Haise, Jr., resigned from NASA at the end of June to join Grumman Aerospace Corp., Bethpage, N.Y., as vice president for space programs.

Haise started his NASA career as a research pilot at the NASA Lewis Research Center in 1959, then spent three years at the Dryden Flight Research Center. Haise was one of the 19 astronauts selected by NASA in April 1966.

He was the lunar module pilot for Apollo 13, April 11–17, 1970. The flight was to be a 10-day mission landing in the Fra Mauro region of the Moon. However, the mission was disrupted enroute to the Moon due to the explosive failure of the service module cryogenic oxygen system, about 55 hours into the flight.

Haise and fellow crewmen, James A. Lovell, Jr., and John L. Swigert, Jr., working closely with the Houston ground controllers at the Johnson Space Center, converted their lunar module into a lifeboat. Their emergency activation and operation of the lunar module systems conserved both electrical power and water in sufficient supply to assure their safe return to Earth.

Haise was the backup lunar module pilot for the Apollo 8 and 11 missions and the backup spacecraft commander for the Apollo 16 mission.

From April 1973 to January 1976, Haise was the technical assistant to the manager of the Space Shuttle Orbiter Project. He was commander of one of the two two-man crews which piloted the Space Shuttle Enterprise on approach and landing test flights from June through October 1977. He was named in March 1978 to command one of the early Space Shuttle orbital flights.

Contractor News

Defense and Space Systems Group of TRW, Inc., Redondo Beach, Calif., has been selected for negotiations leading to the award of a NASA contract entitled "Hardware for NASA Applications Explorer Mission (AEM) and National Oceanic and Atmospheric Administration TIROS-Earth Radiation Budget Experiment." The contract, valued at about $13 million, involves building measurement instruments for the Earth radiation budget experiment program, designed to measure the amounts and effects of solar radiation on the Earth and its atmosphere. Work will be done at the contractor's facility over about 57 months. The contract is managed by the Langley center.

Boston-Bergen Metal Products of Oakland, Calif., has been awarded a $10.7 million NASA contract for construction work in connection with modifications of the largest wind-tunnel facility in the western world. Scheduled improvements in the 12 x 24 meter wind tunnel at the Ames center will significantly improve the national capability for research and development of new aircraft types, especially large helicopters and vertical and short take-off and landing aircraft. Structural modifications are designed to accommodate an increase in the drive power of the wind tunnel. The modified facility, with its two test sections powered by the common drive system, is scheduled to be operational in late 1981.

CEM Associates of Hampton, Va. has won a $2.4 million contract to work on adaptations of the National Transonic Facility wind tunnel at the Langley center. The tunnel will be used to provide test data in the transonic speed range. The contract, to cover a period of 19 months, will be managed by the Langley center.

ARA Services, Inc. of Philadelphia, and **TWA Services, Inc.** of Chicago (the incumbent concessionaire) have responded to requests for proposals to manage and operate the public visitation program at the Kennedy center. Involved in the 10-year concession agreement will be the operation of the guided bus tours of the center and Cape Canaveral Air Force station, as well as the management and operation of the public visitor program.

The Canadian Commercial Corp. has been awarded a NASA letter of contract for the follow-on production of three remote manipulator systems for the Space Shuttle. The work is to be performed by Spar Aerospace LTd. of Toronto. The letter of contract is expected to be replaced later this year with a definitive contract valued at some $60 million. The contract calls for three remote manipulator systems, ground support gear, and logistics support for the Shuttle. The bulk of the work will be performed at Spar's facilities in Canada, with a portion subcontracted to other Canadian and U.S. firms. The manipulator system is a 15-meter arm-like device that will allow astronauts in the Shuttle orbiter to deploy or retrieve payloads in space. Delivery of the three systems to Kennedy is planned between 1982 and 1984.

Did You Know?

The University of Michigan recently devoted an entire issue of the *Michigan Quarterly Review* to Apollo 11, under the title "The Moon Landing and Its Aftermath." The 363-page volume sells for $2.50. Among its 32 contributors are such personages as "James Earl Carter, Jr.," Carl Sagan, and Theodore M. Hesburgh. Two of the authors are NASA employees.

The National Association of Government Communicators awarded a "Blue Pencil" to NASA editor Victor Seigel for the excellence of his work in providing text and pictures for NASA's Landsat wall sheet. He accepted the award for the headquarters publications section at a luncheon held in Washington, D.C.

"Tips for Energy Savers" is the title of a 46-page booklet recently published by the Federal Energy Administration and the Energy Research and Development Administration. It features an introduction by President Jimmy Carter, and numerous notes about the conservation of energy in the home, outdoors and on the road. The publication also lists kilowatt hours used annually by a variety of household appliances. Single copies may be ordered by writing: Tips for Energy Savers, Energy Conservation Now, Pueblo, Colo. 81009.

"Voyager 1—Encounter with Jupiter," a 43-page, full-color publication, recently was published by NASA. It describes the Voyager project briefly, allowing numerous striking photographs of Jupiter and its satellites to tell the dramatic story of this unique planetary investigation.

The Smithsonian Institution's National Air and Space Museum in Washington, D.C. is showing a photography exhibition entitled "Our Beautiful Earth: the View from Air and Space," featuring the work of four contemporary photographers who specialize in aerial views of the Earth. The exhibit, which runs until May 1980, also features photographs taken by NASA astronauts and by Landsat scanners.

Launches for 1979

Name	Launch Date	Vehicle	Range	Mission Remarks
SCATHA	Jan. 30	Delta	ETR	DoD R&D. Spacecraft charging at high altitude Reimbursable.
SAGE-A	Feb. 18	Scout	WFC	NASA applications satellite. Stratospheric aerosol and gas experiment.
FLTSATCOM-B	May 3	Atlas Centaur	ETR	DoD Navy communication satellite. Reimbursable.
NOAA-A	June 27	Atlas-F	WTR	NOAA weather satellite. Reimbursable.
UK-6	June 2	Scout	WFC	UK scientific satellite. Reimbursable.
Navy 20, C/U	July 20	Scout	WTR	DoD Transit Reimbursable.
Westar-C, C/U	August 9	Delta	ETR	Western Union communications satellite. Reimbursable.
Intelsat V-A	August	Atlas Centaur	ETR	Intelsat communications satellite. Reimbursable.
HEAO-C	August 31	Atlas Centaur	ETR	Third high energy astronomical observatory to study highly energetic radiation from space.
MAGSAT-A	September 7	Scout	WTR	NASA applications satellite to study magnetic field.
Navy-21	October	Scout	WTR	DoD transit satellite. Reimbursable.
SMM-A	October	Delta	ETR	NASA solar maximum mission satellite.
RCA-C	December	Delta	ETR	Domestic communications satellite. Reimbursable.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer	Title	Patent No.	Installation
Hubert C. Vykukal, ARC	Spacesuit mobility joints	4,151,612	ARC
Robert L. Dotts, Robert J. Maraia, James A. Smith, Ivan K. Spiker, George Strouhal; JSC	Thermal insulation protection means	4,151,800	JSC
Theodore F. Ciszek, Guenther H. Schwuttke; Int. Bus. Machines Corp., Hopewell Junction N.Y.	Growth of silicon carbide crystals on a seed while pulling silicon crystals from a melt	4,152,194	NRLO
Lien C. Yang, JPL	Underwater seismic source	4,153,134	NRLO
Benjamin Shelpuk, JPL	Double-sided solar cell	4,153,476	NRLO
Radford R. Gooloe, Donald B. Leininger, Pierce C. Toole, Jerry L. Belt; Planning Res. McLean, Va.	Telephone multiline signaling using common signal pair	4,153,818	KSC
Peter H. Broussard, John L. Burch, Edward J. Drost, Richard J. Stein; MSFC	Coal-shale interface detection	4,154,084	MSFC
Robert D. Lee, ARC	EKG and ultrasonoscope display	4,154,230	ARC
Brent A. Miller, LeRC	Self stabilizing sonic inlet	4,154,256	LeRC
James R. Fischer, GSFC	Interleaving device	4,154,501	GSFC
John J. Deluca, GSFC	Bonding of sapphire to sapphire by Eutectic mixture of aluminum oxide and zirconium oxide	4,155,475	GSFC
Robert D. Lee, ARC	EKG and Ultrasonoscope display	4,156,304	ARC
Donald E. Routh, Ben R. Hollis, William R. Feltner; MSFC	Method of construction of multi-cell solar array	4,156,309	MSFC
Willard W. Anderson, LeRC, Nelson J. Groom	Magnetic suspension and pointing system	4,156,548	LeRC
Salvatore R. Riccitiello, ARC	Fire protection covering for small diameter missiles	4,156,752	ARC
Warren H. Phillipp, LeRC, Li-Chen Hsu	*In situ* self cross-linking of polyvinyl alcohol battery separators	4,154,912	LeRC

New Display—Ray Cerrato (left), chief of KSC's research and technology projects branch, and Marvin Yarosh, associate director of the Florida Solar Energy Center, examine the solar index reporter recently installed at KSC's visitors center. The unit displays in a digital format the amount of sunlight that fell in the area the previous day, the accumulated energy for the current day, and the sun intensity at the moment. Equipped with a voice synthesizer, the reporter is accessible by telephone.

NASA Aircraft Takes Part in Monsoon Study

A research aircraft from NASA's Ames Research Center, arrived in Dhahran, Saudi Arabia, on May 3 to take part in a summer-long international study of the summer monsoon, the tropical wind phenomena that brings torrential rains to the Asian subcontinent each year.

Monsoons, responsible for nearly 100 percent of the area's annual rainfall during the months of June, July and August, are a mixed blessing. The downpours furnish needed moisture for crops which feed hundreds of millions of people. But the heavy rains wreak havoc as swollen rivers and streams spread over the surrounding communities. Last year more than 900 people died in the monsoon floods and more than three million were left homeless.

The research study, called MONEX (for monsoon experiment), is an international effort to explore the origin of the monsoon winds to improve short-range predictions and to better understand the role of monsoons in global weather patterns.

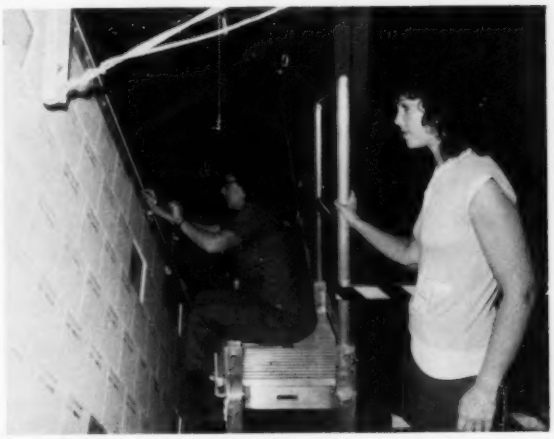
Ames' Galileo II, a four-jet Convair 990 research aircraft, operated from bases in Saudi Arabia and elsewhere in the region in May and June. Its activities were coordinated with those of several other aircraft, ships and a variety of ground-based facilities including self-recording surface stations, portable radiosondes and digital radars. Intensive measurements taken over a 73-million square kilometer area will form a part of global atmospheric research program on an even larger scale being conducted by the World Meteorological Organization of the United Nations.

According to Joachim Kuettner, director for the U.S. MONEX participation: "MONEX will make a major advance in weather prediction in southwest Asia. This area is practically devoid of basic weather data, so that predictions of even a day or two in advance would be extremely useful."

A variety of instruments has been installed aboard Galileo II to measure density, temperature, pressure and humidity of the atmosphere; the chemical composition of aerosols; and concentrations of carbon monoxide and various atmospheric trace gases. Other instruments will measure radiation budget, ultra violet sky radiance, relative temperatures at the surface and the atmospheric electric field. Various camera systems will record cloud formations.

Galileo II is operated by the Ames center as a flying laboratory capable of carrying scientific payloads to altitudes of up to 12,500 meters. The aircraft provides experimenters with a stable plaform from which they can conduct studies in aerodynamics, Earth resources, mapping, oceanography, polar ice fields, meteorology, stratospheric and ionospheric physics, astronomy, geophysics, aurora and airglow and life sciences.

The aircraft will return to California via the Far East and Alaska, completing a circumnavigation of the world.



Inspecting Columbia's Thermal Blanket—On a visit to the Kennedy center, astronaut candidate Judith Resnick examines a portion of *Columbia's* thermal protection system which is made up of about 34,000 individual ceramic-coated tiles. In the background, a Rockwell technician carefully prepares the orbiter's aluminum skin surface for bonding one of nearly 10,000 tiles still to be installed to complete *Columbia's* thermal blanket. Resnick's recent tour of the orbiter processing facility, where *Columbia* is being readied for its maiden launch, followed her participation in National Secretaries Week activities which included giving a short talk at a special program attended by over 280 civil service and contractor secretaries. Later she signed autographs and shook hands with Kennedy center secretaries at a reception in the mission briefing room.

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Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Diagnostic System for Auto Engines

A commercial product called "Autosense*," a computer-operated diagnostic system for isolating malfunctions in autos and trucks, stems from an environmental control and life-support system for a prototype space station developed under a NASA contract with Hamilton Test Systems of Windsor Locks, Conn.

Included in the development was a subsystem whose job was to monitor the performance of various items of equipment, detect failures, and identify the specific malfunctioning unit. The technology thus acquired provided a springboard to the system now used in automotive centers.

Autosense goes much further than some older diagnostic devices. In just 25 minutes, it can run through a "total auto health check," comparing operation of each part with factory specifications. The system is employed by used- and new-car dealers to satisfy customers that the vehicle they are buying is in tiptop shape. Also used at repair stations, Autosense not only identifies trouble but also tells the mechanic—*and* the customer—why a component is malfunctioning and how it may be repaired. After repairs have been made, a second health check printout shows the customer that the problem has been corrected.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of such technology.

For the benefit of all . . .

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